INDIANA DEPARTMENT OF TRANSPORTATION

Driving Indiana's Economic Growth

Design Memorandum No. 08-08
Technical Advisory

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TO: **All Design, Operations, and District Personnel, and Consultants**

FROM: ***/s/ Richard L. VanCleave***
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SUBJECT: **High-Tension Cable Barrier System**

ADDS: ***Indiana Design Manual*** **Sections 17-3.14 and 49-4.06**

EFFECTIVE: **September 4, 2008, Letting**

A. Introduction

A High-Tension Cable Barrier System (CBS) should be considered in the median of a high-speed roadway where fatal median-crossover crashes have been reported or are anticipated.

B. Warrants

A CBS is a flexible median barrier with a larger lateral deflection during a vehicle impact than a semi-flexible barrier such as a double-faced W-beam or thrie-beam guardrail. The lateral deflection of a CBS is 6.6 ft to 9.2 ft (2 to 2.8 m). A CBS may be used in a median of at least 36 ft (11 m) width if the barrier is located close to the center of the median. It should not be located in a ditch bottom or flow line, so as to avoid potential drainage problems.

A National Cooperative Highway Research Program *Report 350* Test Level 4 (TL-4) CBS, if warranted, should be specified for an Interstate route. A TL-3 CBS, if warranted, should be specified for a non-Interstate route.

See the INDOT *Standard Drawings* for information on locating a CBS in a median which includes a bridge support, existing concrete barrier or guardrail, impact attenuator, or other safety hardware.

C. Advantages

1. A CBS can be installed in an existing median with a minimum of site work as one of the most cost-effective choices of median barrier.

   The cost of a CBS is almost the same as that of double-faced W-beam guardrail. Compared to double-faced W-beam guardrail, the repairs to a CBS are relatively simple, faster, and should not require driving posts or replacing rails.

2. Vehicle containment and redirection are effective over a wide range of vehicle sizes and installation conditions. Deceleration forces upon vehicle occupants are low.

3. A vehicle impact results in less damage to the vehicle and barrier, and results in less injury to vehicle occupants. The cable often remains at the proper height after an impact that damages several posts. A CBS can sustain multiple impacts and still remain effective.

4. The posts are installed in sleeves in the ground to facilitate removal and replacement.

5. Its open design does not generate drifting of sand or snow on or alongside the roadway.

6. Once maintenance crews have developed the skills to rapidly repair a CBS, maintenance costs can be reduced.

D. Disadvantages

1. A comparatively long length of CBS is non-functional, and is therefore in need of repair following a vehicle impact.

2. A large clear area is needed behind the barrier to accommodate the design lateral deflection distance.

3. A CBS has reduced effectiveness on the inside of a horizontal curve.

4. There is little installation tolerance in obtaining the specified barrier height.

5. Maintenance is often required.

E. Design Considerations

1. Deflection. A CBS redirects an impacting vehicle after sufficient tension is developed in the cable, with the posts in the impact area offering only slight resistance. A deflection distance of 10 ft (3 m) should be provided. The clearance between the cable and the opposing traffic's median edge of travel lane should be at least 10 ft (3 m).

   The use of a CBS where it is likely to be impacted frequently, such as on the outside of a sharp horizontal curve, is not recommended.

2. Slope Requirement. A CBS should not be constructed on a slope steeper than 6:1. The approach should be relatively flat, without a curb or a ditch.

3. Transverse Location in Median. The post offset from the centerline of a median V ditch should desirably be at least 8 ft (2.4 m), or minimally within 1 ft (0.3 m) of the centerline. The post offset from the edge of a median flat-ditch bottom should desirably be at least 8 ft (2.4 m) or minimally within 1 ft (0.3 m) of the ditch line. The post offset from the edge of paved shoulder should desirably be at least 12 ft (3.6 m) to avoid nuisance impacts. The desirable conditions described above require a minimum medium width of 48 to 52 ft (14.5 to 15.8 m) for proper placement of a CBS assuming that the paved shoulder and flat-bottom ditch widths are each 4 ft (1.2 m).

4. Line Post and Anchor Foundations. Each end of a CBS run must be anchored. The designer should initially prepare a layout plan and request a geotechnical investigation of soil conditions for approximate locations of the safety terminals and representative locations of the intermediate line-post foundations. The geotechnical-investigation findings should be incorporated into the contract documents. End-anchor and line-post-foundation sizes are determined by soil classification, condition, temperature extremes, etc.

5. Line-Post-Foundation Size. The foundation for an intermediate line post should have a minimum depth of 3.5 ft (1.1 m) and a minimum diameter of 14 in. (350 mm), with the foundation top flush with the ground level.

6. CBS Run Length. The recommended minimum run length is 1000 ft (300 m). The recommended maximum run length is 10,000 ft (3000 m) between anchors.

   The number of median crossovers for emergency vehicles should correspond to that required with a concrete or thrie-beam median barrier.

7. Clearance to Rigid Obstacle. The lateral clearance to a rigid obstacle such as a bridge pier, sign support, utility pole, tree, etc., should be 10 ft (3 m).

8. Placing CBS in the Vicinity of Another Barrier. If the side slopes are not steeper than 6:1 and another barrier is parallel to the roadway, the CBS can be tapered on a 50:1 or flatter taper. The end terminal should be placed behind the other barrier. A minimum lateral clearance of 10 ft (3 m) from the end treatment of the parallel barrier is recommended. If the other barrier is flared, the CBS may be connected to W-beam or thrie-beam guardrail using an attachment to the guardrail end terminal that is available from the manufacturer.

9. Placing CBS in Vicinity of Inlet or Dike. If a drainage inlet, dike, etc., is encountered and cannot be adjusted to the proper grade, the CBS alignment should be gradually transitioned around it to ensure that the correct cable height above the ground line will be maintained. The horizontal transition should be on a taper of 50:1 or flatter.

10 CBS at Crossover. For a CBS termination at a median crossover, the CBS end terminal (end anchor) should be located beyond the tangent points of the crossover, preferably 3 to 5 ft (1 to 1.5 m) from the tangent point.

11 Changing Offset of CBS in a Median from Being Closer to One Roadway to Being Closer to the Opposing-Traffic Roadway. If a CBS requires a change of lateral offset, the end anchors of the CBS should be overlapped for the minimum distance between the anchors in each direction as described below. The minimum distance for the anchor located at the incoming end should be at least the runout length, L_R, used for calculating the guardrail length of need. An overlap distance of 500 ft (150 m) should be used for a median width up to 60 ft (18 m), a design speed of 70 mph (110 km/h), and AADT > 6000. For the anchor located at the outgoing end, the minimum overlap distance should be two times the anchor length. Changing the lateral offset of a CBS at the anchor located at the outgoing end is the preferable method.

12 Locating the End Anchor of CBS in the Vicinity of Impact Attenuator. If a CBS is terminated in the vicinity of an impact attenuator, the entire end-anchor length should be located at the distance shown on the INDOT *Standard Drawings* behind and clear of the concrete attenuator pad.

F. Contract-Documents Requirements

1. Plans. The longitudinal and transverse CBS locations should be shown on the plans. A geotechnical investigation of the soil conditions will be required for the approximate locations of the safety terminal and the representative locations of the intermediate line-post foundations at the respective sites throughout the entire length of the proposed barrier installation. The geotechnical-investigation results should be incorporated into the contract documents.

2. Quantities. The length of each end terminal should be included in the quantities for CBS. A safety terminal should be included for each end of each CBS run. One spare-parts set should be included. The plans should show all necessary linear-grading work to be done in the median. The quantities should be included in a pay item for linear grading. A traffic-control plan should be included, along with a pay item for maintaining traffic.

3. Recurring Special Provision and Recurring Plan Detail. Recurring Special Provision 627-R-546 and Recurring Plan Detail 627-R-546d, attached hereto, should be called for beginning with the July 9, 2008, letting, and through the August 2010, letting.

   The recurring special provision must be reviewed to verify that it is adequate to provide for the installation of a CBS. If necessary, a unique special provision must be written to incorporate contract-specific requirements.

4. Pay Items. The code numbers, pay items, and pay units are as follows:

627-09326	Cable Barrier System, Type TL-3	LFT (m)
627-09330	Safety Terminal, Type TL-3	Each
627-09328	Cable Barrier System, Type TL-3, Spare Parts	Each
627-09327	Cable Barrier System, TL- 4	LFT (m)
627-09331	Safety Terminal, TL- 4	Each
627-09329	Cable Barrier System, TL-4, Spare Parts	Each